Track & Know

PROJECT
NEWSLETTER

WELCOME TO THE FIFTH TRACK & KNOW NEWSLETTER!

In this newsletter, you can find:

- A look back at what we have achieved in 2019
- A flash forward to the upcoming Summer School on Data Science for Mobility, supported by Track & Know
- A closer look at the Weather Integrator software
- An update on recent publications & dissemination activities
- We put our project video in the spotlight

ABOUT THE NEWSLETTER

This newsletter provides an update on the results and activities of the EU H2020 research project Track & Know. The aim is to ensure that those interested in managing big data are kept up to date with our latest developments, specifically mobility data and the tools/methods we develop to handle, analyse and visualize these datasets. Track & Know aims to answer industry generated questions in 3 test pilots in the transport/mobility, insurance and health care sectors. The business cases explored in these pilots centre on answering questions around minimizing patients travel, carpooling and electric mobility potential and driver behaviour profiling.

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What have we achieved in 2019?

As published on the **Big Data Value website** - Author: Jenny Rainbird, Inlecom Systems

As Track&Know enters the final year of research and development, we look back over 2019 at what we have achieved. One of the major objectives of the Track&Know project is to **integrate online data streams, heterogeneous, contextual and archival data on one big data platform**. This enables big data experts and stakeholders to advance their operational, processing and decision-making activities. Over the past year we have developed the **big mobility data integrator (BMDI)** which is a fully featured industrial grade solution that is able to scale out and accommodate big data from different domains, interoperating with modern data storage technologies as well as other persistence approaches and that can support all important programming languages including Python, Java, R and Scala as well as other traditional programming approaches.

The big data platform consists of data sources and data store components, connectors together with the Communication platform an underlying infrastructure and Big Data Apps such as the big data processing (BDP) toolbox, the big data analytics (BDA) toolbox, the complex event recognition (CER) toolbox and the visual analytics (VA) toolbox which are being used in the three project pilots for Fleet Management, Car Insurance and Healthcare Services.

A number of tools have been developed for the platform including Big Data processing. The data cleansing and enrichment tool is a scalable solution for online processing of streaming mobility data, which takes as input streaming GPS traces, performs cleansing and map-matching, enriches them with selected traffic data, weathers attributes indicating road conditions (e.g., wind, rain or ice) and nearby fuel stations and other points-of-interest (POIs), which will be used in the pilots related to mobility and insurance.

The tool is built on top of scalable big data processing technologies, including Kafka and Spark Streaming. Eventually, it will help improve the accidents risks estimation, hot spot analysis and electric mobility analysis.
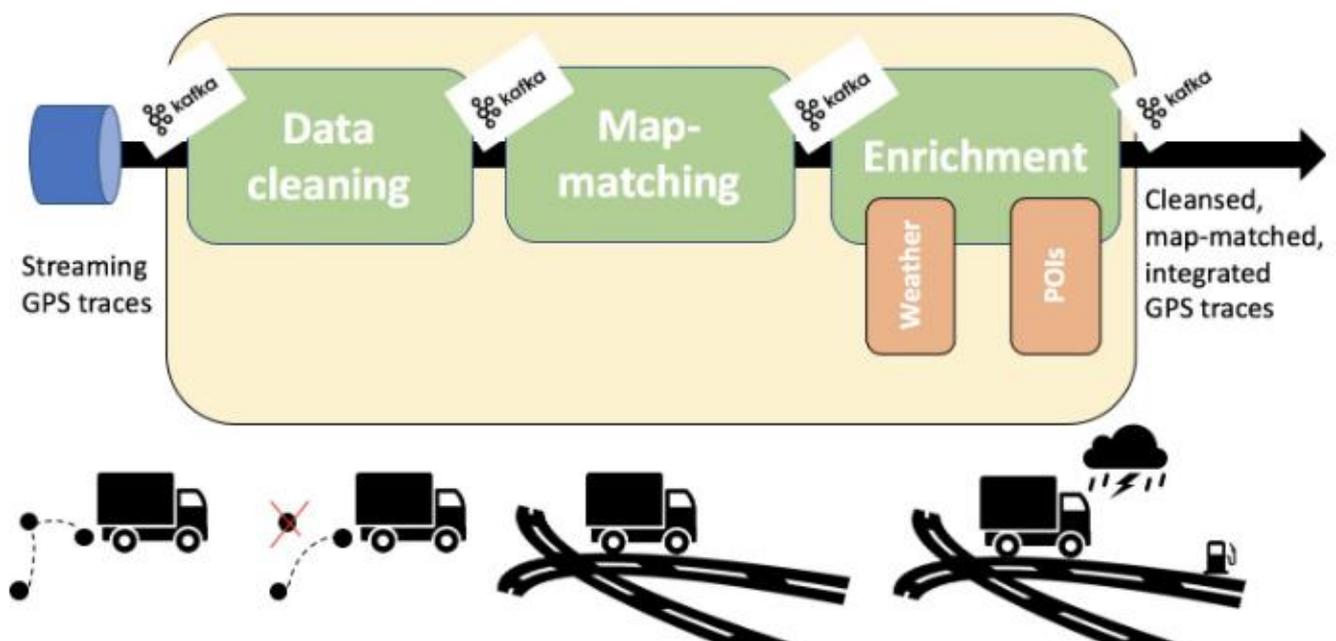

Fig. 1: **The data cleansing and enrichment pipeline** developed in Track & Know for online processing and enrichment of streaming GPS traces.

The Big Data Analytics tool, is a crash prediction tool which can be used to assess the risk of an individual accident predicted through a combination of mobility modelling and Artificial Intelligence techniques. State-of-art machine learning models are applied based on sophisticated indicators that capture individual mobility distribution, driving behavior events, time evolution of mobility demand. This will be used in the insurance pilot and helps estimate risk scores as well as provide individual AI-supported feedbacks for users to improve their driving safety.
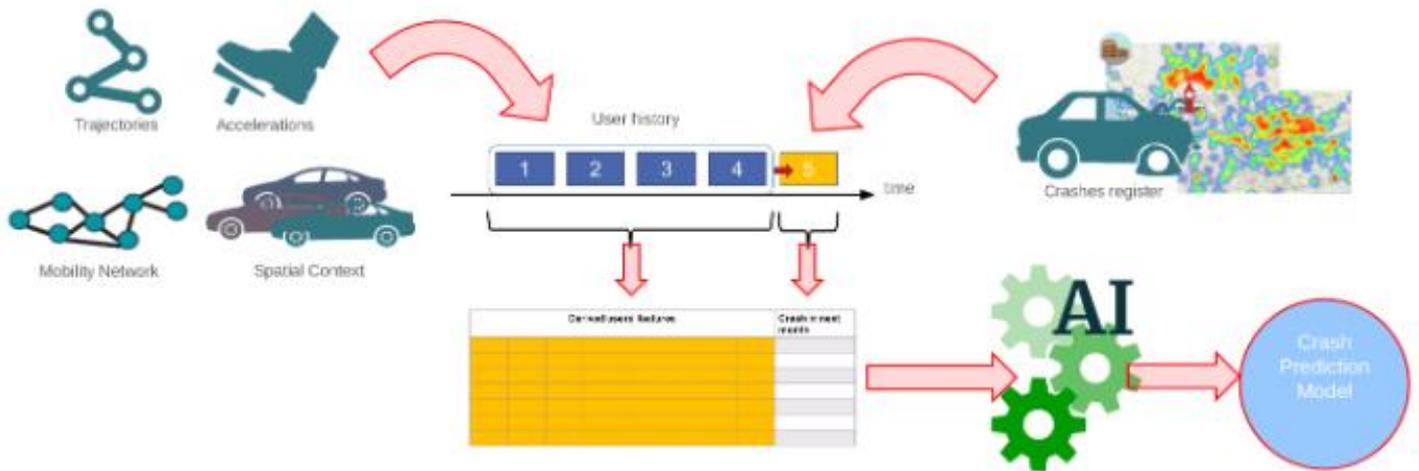

Fig. 2: **The Track & Know process for predicting crash risks.** Prediction models are built out of raw mobility traces through AI- and Mobility Analytics-based processes.

Track & Know has also worked on answering business questions for the Royal Papworth Hospital (RPH, UK) regarding their services for Obstructive Sleep Apnoea (OSA) patients. Due to the high risks associated with OSA patients driving, RPH want to understand whether they can reduce the travel distance for their patients. Track & Know have been analysing patient attendance, no-show rates and distances travelled and so far, the results helped RPH understand the optimum geographical location for outreach clinics helping them to improve their services.

Track & Know has been promoting it's research results over the year, attending and presenting at prestigious events across Europe and Asia and being shortlisted the BDV PPP summit 2019 "success stories awards" and receiving the EuroVA 2019 ''Best Paper Award''.
2020 will be the final year of the project and the focus will be on the final development and integration of the toolboxes in the platform and the use of these tools in the three pilot studies, we will also be looking at the sustainability of the research particularly the patenting and commercialisation of our results and via open source platforms sharing much of our research with the wider community.

Pic. 1: **Track & Know 'Speed dating workshop'** Hasselt University, November 2019

First International Summer School on Data Science for Mobility

About

The objective of the **First International Summer School on Data Science for Mobility,** supported by Track & Know, is to offer to participants both visionary keynote speeches and hands-on mini courses. The keynote speeches are given by leading experts on maritime and aviation domains introducing analysis challenges a large quantity of very complex mobility data generated every day.

Aim of the school

Massive amounts of spatio-temporal data, representing trajectories of moving objects are produced by an ever-increasing number of diverse, real-life applications, ranging from mobile to social media apps and surveillance systems, from vehicle tracking systems to IoT mobile sensors. Such mobility-aware traces come in huge numbers and very complex forms, and can be enriched with multiple different semantic dimensions. These semantically enriched trajectories have the potential to unveil novel challenges in several domains, such as urban, maritime and aviation.

The explosion in Data Science is happening now. The Big Data technological infrastructure has reached maturity. Significant interest from the research community is being shown towards the Big Data Value Analytics reference model: data management, data processing, data analytics, data visualization. The time is right for the field of Mobility Data Science to follow the trend!

Target groups

This Summer School is intended for PhD students, researchers and practitioners in the fields of Computer and Information Science, interested in learning about the most recent developments in mobility data science. Attendees will familiarise themselves with the most recent data science trends, including deep learning and AI methods for mobility data, methods to analyse human mobility as well as with methods for big mobility data. With the hands-on experience participants will gain familiarity with some commonly used tools and datasets.

Course aim

At the end of the course, each attendee will:

- Understand how to analyse mobility data with deep learning techniques

- Understand how machine learning and AI methods can be tailored to mobility data

- Understand how to manage Big Mobility Data

- Gain significant hands-on experience with state-of-the-art technologies and tools

- Have a vision of open research as well as technological challenges customized to key application areas and domains

FIRST INTERNATIONAL SUMMER SCHOOL ON
DATA SCIENCE FOR MOBILITY

April 27 - May 1, 2020

Kastelli Resort

Kamari Village, Santorini, Greece

[Click here for full info and registration](#)

Weather Integrator Software

A software module within the Big Data Processing (BDP) Toolbox

In the Track & Know project, **positional data of moving vehicles are further enriched with a variety of information**. One important enrichment that has been made is **integration of weather information**. This enrichment of positional data is useful to improve mobility data analysis tasks in several use case scenarios in pilots related to mobility and insurance. It will help improve the accidents risks estimation, hot spot analysis and with certain other assumption also improve the electric mobility analysis.

An example is demonstrated in the below image, where the trace information of a moving vehicle is enriched with several weather attributes.

Software Details and Features

This software provides a **mechanism for enriching spatio-temporal point records (records that contain longitude, latitude and date information) with weather data**; attributes that describe characteristics of the prevailing weather conditions, such as temperature. The weather data can be found in GRIB files that store the values of weather attributes in serialized form and refer to a specific time period and to a specific geographical area (or the whole globe).
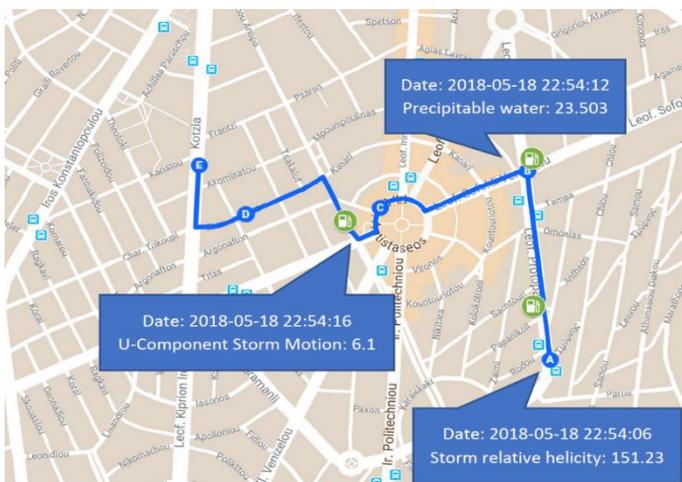

Fig. 3: Map with trace information of a moving vehicle, enriched with several weather attributes

- The records of spatio-temporal points (dataset) that are to be enriched, may be stored in files (such as CSV) or in a Kafka topic

- The records of spatio-temporal points (dataset) that are to be enriched may be either in JSON or in delimiter separated format

- The output result (enriched records) may be written either in files or in Kafka topic

- The weather data source can be accessed either locally or via HDFS during the integration procedure

More information on the software can be found via the github repository.

Download this software via the online Track & Know observatory

Key Dissemination and Liaison Activities

Track & Know presented at annual EU Big Data Value Forum in Helsinki

Prof. Yannis Theodoridis and **Dr Ibad Kureshi** represented the Track & Know project at the **EU Big Data Value Forum**, held from 14th to 16th October in Helsinki (Finland). The Track & Know project was showcased once again as **a top five success story** during the Best Success Story and I-Space Label 2019 Ceremony session.

Track & Know was also present at the **Big Data Value Association booth**. This opportunity was used to create new clustering and liaison activities with other Big Data PPP and BDVA related projects.


Pic. 2: **Dr. Ibad Kureshi** at the EU Big Data Value Forum in Helsinki (Finland)

Track & Know health pilot update presented at British Sleep Society conference

At the recent **Bi-Annual British Sleep Society conference in Birmingham** (UK), **Kieran Lee** from the Royal Papworth Hospital presented a poster on going work in pilot study 2.

This Track & Know pilot is looking at the network of patient journey flows to pick up oximetry OSA screening tests over the Royal Papworth Hospital catchment area. The work highlights geographical areas with a high demand for a test that are currently required to travel large distances to access one. The hospital is now in the process of updating its booking process as a direct result of this work.

Click the poster on the right for a read-friendly version.
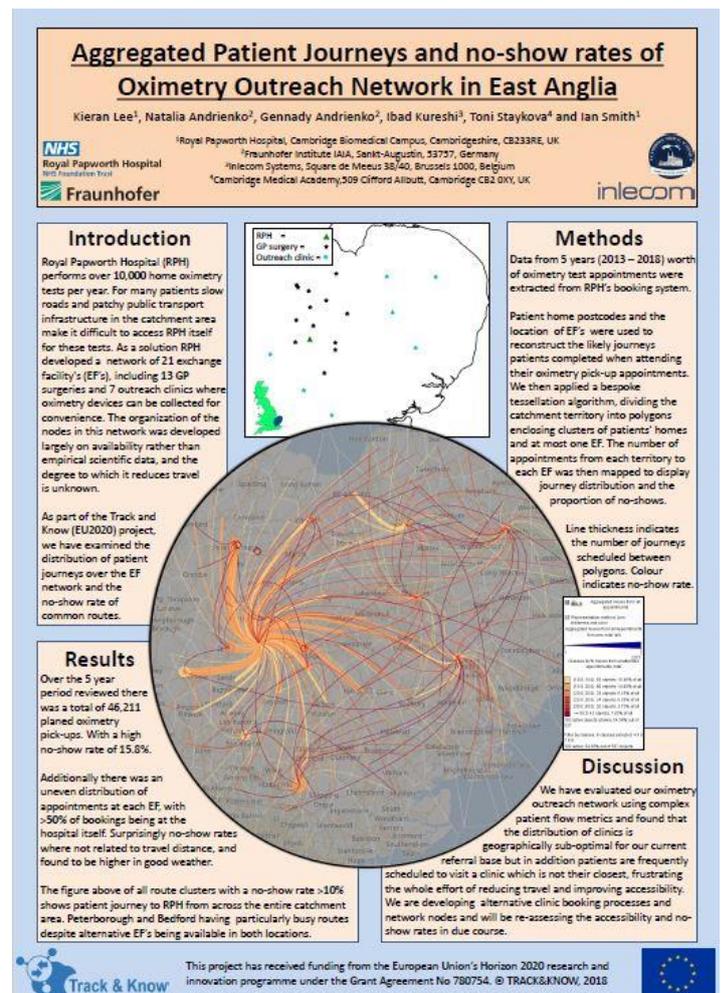
Pic. 3: **Health pilot poster** as presented by Kieran Lee at the Bi-Annual British Sleep Society conference in Birmingham (UK)

Track & Know paper about travel time distributions estimation published

A Track & Know research paper **titled "Estimation of travel time distributions for urban roads using GPS trajectories of vehicles: a case of Athens, Greece"** has recently been published online.

This paper by Adnan, M., Gazder, U., Yasar, A.-u.-H., Bellemans, T. and Kureshi, I focusses on **travel time distribution and associated variability which is highly important to a variety of transport planning, traffic management, and control projects.**

Track & Know project video released

The Track & Know consortium recently released the official project video to clarify what this H2020 project is all about and what it is aiming for.

Please don't hesitate to like and share this project video (and other interesting posts) via the Track & Know social media channels.

- **Facebook**
- **Linkedin**
- **Twitter**

Click the below screen to view the full video online.

PUBLICATIONS 2019 - 2020

- Nikitopoulos P., Sfyris G. A., Vlachou, A., Doulkeridis C., Telelis O. (2019) Parallel and Distributed Processing of Reverse Top-k Queries, In *Proceedings of the 35th IEEE International Conference on Data Engineering* (ICDE 2019). Download **here**

- Andrienko N., Andrienko G., Garcia J. M. C., Scarlatti D. (2019) Analysis of Flight Variability: a Systematic Approach, *IEEE Transactions on Visualization and Computer Graphics*, vol. 25(1), pp.54-64. Download **here**

- Liua S., Andrienko G., Wu Y., Cao N., Jiang L., Shi C., Wang Y. S., Hong S. (2019) Steering Data Quality with Visual Analytics: the Complexity Challenge, *Visual Informatics*, vol 2(4), pp.191-197. Download **here**

- Koutroumanis N., Santipantakis G., Glenis A., Doulkeridis C.,Vouros G. (2019) Integration of Mobility Data with Weather Information, In Proceedings of *International Workshop on Big Mobility Data Analytics (BMDA'19), Lisbon, Portugal, March 26, 2019.* Download **here**

- Guidotti, R, Monreale A, Cariaggi L (2019). Investigating Neighborhood Generation Methods for Explanations of Obscure Image-Classifiers, In: Yang Q., Zhou ZH., Gong Z., Zhang ML., Huang SJ. (eds) *Advances in Knowledge Discovery and Data Mining. PAKDD 2019. Lecture Notes in Computer Science, vol 11439.* Springer, Cham. Download **here**

- Chen S., Andrienko G., Andrienko N., Doulkeridis C., Koumparos A., (2019) Contextualized Analysis of Movement Events, In: T. V. Landesberger and C.Turkay (Eds) *EuroVis Workshop on Visual Analytics (EuroVA)*, pp: 49- 53, The Eurographics Association. ISBN: 978-3-03868-087-1, DOI: 10.2312/eurova.20191124. Download **here** (This publication received the 'EUROVA 2019 best paper award')

- Koutroumanis N., Nikitopoulos P., Vlachou A., Doulkeridis C. (2019): NoDA: Unified NoSQL Data Access Operators for Mobility Data. In *Proceedings of the 16th International Symposium on Spatial and Temporal Databases (SSTD'19).* Download **here**.

- Tsilionis E., Koutroumanis N., Nikitopoulos P., Doulkeridis C., Artikis A. (2019): Online Event Recognition from Moving Vehicle. In *Proceedings of the 35th International Conference on Logic Programming (ICLP'19)*. Download **here**.

- Nanni, M., Longhi, L. (2019): Vehicle mobility data analysis and Individual Mobility Networks for crash prediction. Journal of Ambeint Intelligence and Humanized Computing, DOI: https://doi.org/10.1007/s12652-019-01632-4 Download **here**

- Adnan, M, Gazder U., Yasar A. H., Bellemans T., Kureshi, I (2020), Estimation of travel time distributions for urban roads using GPS trajectories of vehicles: a case of Athens, Greece, *Personal and Ubiqutious Computing*, DOI: https://doi.org/10.1007/s00779-020-01369-4, Download **here**

- Theodoridis Y. (2020) Learning from Our Movements – The Mobility Data Analytics Era. In: Tserpes K., Renso C., Matwin S. (eds) Multiple-Aspect Analysis of Semantic Trajectories. MASTER 2019. Lecture Notes in Computer Science, vol 11889. Springer, Cham. Download **here**

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